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THE PHILLIPS CURVE IS STILL ALIVE. INTERPRETATION OF LOW INFLATION EPISODE IN POLAND

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ABSTRACT

Deflation in Poland, similarly as low inflation in the advanced economies, particularly in the euro area, seems surprisingly and unexpectedly persistent. This study attempts to verify to what extent traditional and hybrid versions of the New Keynesian Phillips Curve (NKPC, HNKPC) are useful in analyzing recent inflation developments in Poland. To make our analysis comprehensive and the conclusions robust, estimating the New Keynesian Phillips curves we take into account different variables representing inflation, inflation expectations, economic slack and imported inflation.

Our results suggest that the recent disinflation in Poland – that started in 2012 and resulted in a prolonged deflation period – has been driven not only by a fall in commodity prices, but also by demand factors and by a reduced level of inflation expectations. We show that in order to make the HNKPC models able to replicate the recent disinflation, a specific set of proxies for explanatory variables should be used. It should include survey-based measures of economic agents' inflation expectations (particularly, inflation

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expectations of enterprises), the transformed measure of the output gap that allows for a stronger impact of economic activity on inflation when the output gap is high or GDP growth rate relative to its mean as well as the real exchange rate gap.

Analyzing stability of the Phillips curve estimated in terms of core inflation we find some signs of its flattening in recent years. At the same time HNKPC models with CPI inflation as explanatory variable suggest rather a steepening of the Phillips curve. Both types of models indicate, however, that the link between inflation expectations and actual inflation has weakened recently.

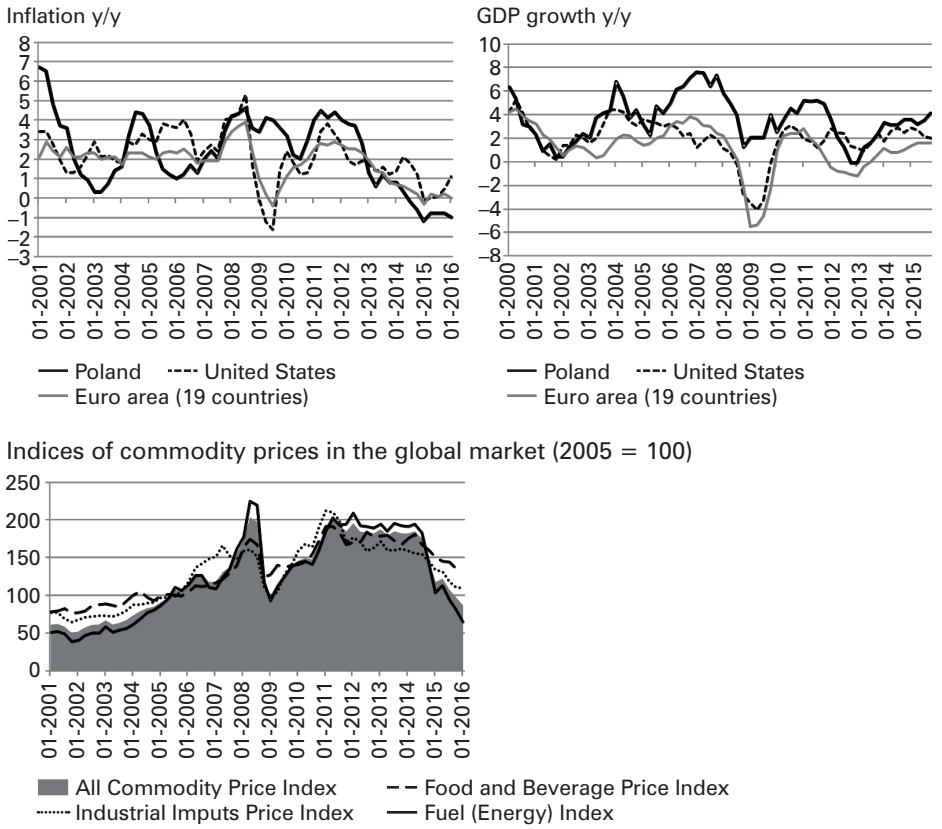
Keywords: inflation, deflation, hybrid new Keynesian Phillips curve, Poland.
JEL Classification: E31, E37

INTRODUCTION

Before the collapse of the Lehman Brothers, many advanced and emerging economies experienced a prolonged period of low and stable inflation. Reduction of the level and volatility of inflation was perceived as a sign of success of central banks, whose credibility contributed significantly to the Great Moderation period. Since the beginning of the Great Recession inflation has become more volatile and its path in advanced economies has displayed a twin puzzle (Constâncio, 2015), i.e. first, a missing disinflation in 2009–2011, and second, excessive disinflation after 2012, particularly in Europe (Figure 1). Even if inflation during both of these episodes was driven by changes in commodity prices, its level seems not fully consistent with developments in the real economy, i.e. with negative growth rates of the real GDP in the U.S. and the euro area after the beginning of the sharp phase of the financial crisis and, more recently, with a gradual economic expansion. A twin puzzle has provoked numerous analyses aimed at assessing to what extent observed inflation developments are consistent with existing models of inflation, particularly with those based on the Phillips curve specifications.

In recent years, inflation in Poland has followed similar developments as in advanced economies (Figure 1, Figure 2). Affected by high energy and food prices it significantly exceeded the inflation target of the National Bank of Poland (2.5% with a range of tolerable deviations ±1 pp.) in the aftermath of the financial crisis (years 2008–2009 and 2010–2012). Then, in 2014–2015 a very fast disinflation took place – CPI inflation was reduced from 4.6% in 2011Q4 to –1.5% in 2015Q1. Since then it has remained in the negative territory till now (2016Q2). It should be noted that the depth of disinflation in Poland has been bigger than in the U.S. and the euro area. It is probably mainly due to a different composition of consumer baskets – the share of foodstuffs and energy in Poland is significantly bigger than in the U.S. and in the euro area (Table 1).

Figure 1. Inflation developments in the U.S., euro area and Poland and their selected determinants



Source: Eurostat, IMF.

Table 1. Composition of consumer baskets in Poland, U.S. and the euro area

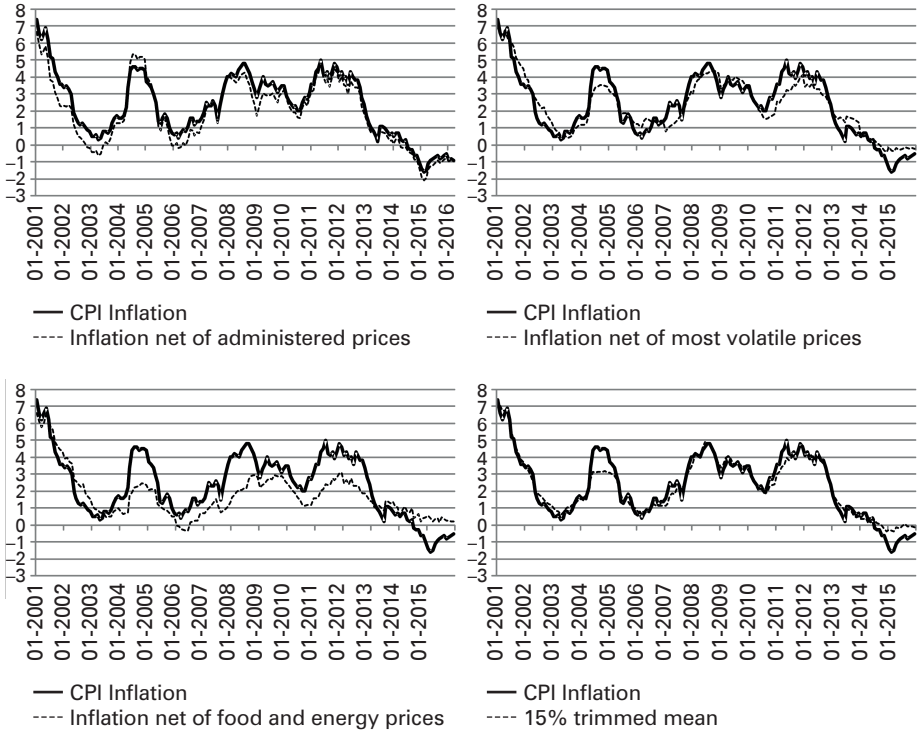
	Poland	U.S.	Euro area
Food and non-alcoholic beverages	24.4	15.6	8.4
Energy	17.6	10.7	7.0
All items less food less energy	58.1	73.7	84.6

Notes: Energy items contain two categories of items, i.e.: electricity, gas and other fuels (COICOP 04.5) and fuels and lubricants for personal transport (COICOP 07.2.2).

Source: OECD.

The deflation in Poland has been broad-based – at its early stage, in late 2014, the weight of CPI basket components, whose prices displayed reductions on annual basis was approaching as much as 45% (NBP, 2014, p. 22). Moreover, not only CPI inflation was subject to significant reductions but also core inflation measures. Since 2014 the latter ones either have been negative (inflation net of administrative prices) or have oscillated around the levels close to zero (inflation net of the most volatile prices, inflation net of food and energy prices and 15% trimmed mean).

Figure 2. CPI inflation and different measures of core inflation in Poland (year-on-year changes, %)

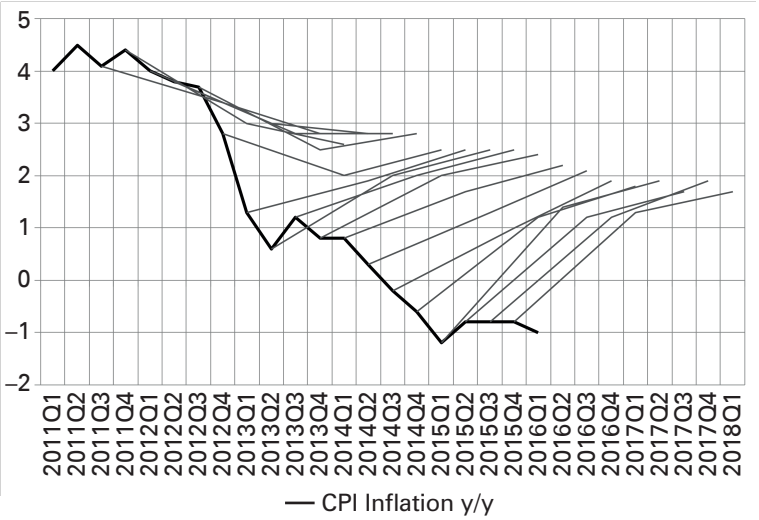


Source: GUS, NBP.

Two aspects of Polish disinflation should be emphasized. First, both the magnitude of disinflation and the persistence of negative inflation rates were expected neither by professional forecasters (see Figure 3), nor by monetary authorities.[1] Second, contrary to the most common explanation of low inflation in Poland, treating it as a global phenomenon, resulting mainly from a sharp fall in commodity prices in the global markets, very low levels of core inflation measures indicate that the reasons of deflation are more complex.

[1] See macroeconomic projections presented in NBP *Inflation Reports* (NBP, 2014).

Figure 3. CPI inflation (year-on-year changes, %) and the forecasts of professional experts (NBP SPF)



Notes: Thin lines show the paths of forecasts by the experts of the NBP Survey of Professional Forecasters. They were interpolated based on forecast of inflation 4- and 8-quarters ahead. The line that starts in a given quarter is the interpolated forecast from the survey conducted one quarter later.

Source: GUS and NBP.

The above circumstances lead to the question whether the period of low and negative inflation in Poland should be considered puzzling from the point of view of our understanding of the nature of inflation processes in Poland. To what extent are the Phillips curve models alive, able not only to describe recent inflation performance, but also to forecast inflation in advance? What are determinants of deflation in Poland?

The present study aims at answering the above questions. Referring to selected studies that analyze inflation puzzles in the U.S. and euro area economies, we perform similar analysis using Polish data. The main focus is to verify if the recent disinflation can be explained *ex post* and if it could have been predicted *ex ante* with the use of the hybrid New Keynesian Phillips curve. Estimating it we use different measures of the economic slack and inflation expectations, trying to find the most accurate specification. In addition, we analyze changes in the estimation results of the Phillips curve during the recent disinflation in Poland.

The second section provides a brief review of the literature, focusing on selected studies being the most relevant for our analysis. The third section discusses methods and data used in the empirical part of the article. The fourth section presents the results. The final section concludes the study.

1. LITERATURE REVIEW

The Phillips curve can be broadly described as the relationship between inflation and economic slack, extended with additional factors affecting price changes. In the New Keynesian framework they include in particular inflation expectations. Such a relationship is known as the New Keynesian Phillips Curve, NKPC (Goodfriend and King, 1997). It assumes that in every period only a fraction of prices ($1 - \alpha$, $0 < \alpha < 1$) are adjusted, while the remaining ones (α) stay unchanged. As a result, the current inflation rate (π_t) is a function of currently expected price changes ($E_t\pi_{t+1}$), treated usually as rational, and of cyclical component of economic activity ($\hat{y}_t$), i.e. the deviation of output or real marginal costs from their trends[2]:

$$\pi_t = \beta E_t\pi_{t+1} + \kappa\hat{y}_t + \varepsilon_t. \tag{1}$$

For open economies, the above relationship is extended to include terms of trade, real exchange rate or import prices (e.g. Galí and Monacelli, 2005; Abbas *et al.*, 2016).

From the empirical point of view, there were some doubts concerning the NKPC. Such a relationship neither explains the phenomenon of persistently high inflation nor predicts costs of disinflation that in real economy seem substantial (e.g. Ball, 1993; Fuhrer and Moore, 1995). This empirical inconsistency led to an alternative specification of the above relationship, i.e. to the Hybrid New Keynesian Phillips Curve, HNKPC, in which explanatory variables additionally contain lagged inflation :

$$\pi_t = \omega E_t\pi_{t+1} + (1 - \omega)\pi_{t-1} + \kappa\hat{y}_t + \varepsilon_t. \tag{2}$$

The role of lagged inflation is explained in various ways. It can result from the wage contracting model (Fuhrer and Moore, 1995), in which agents aim at maintaining a given level of the real wage during the time of the contract. It can also reflect heterogeneity of economic agents and the hybrid model of formation of their expectations (Lovell, 1986; Roberts, 1997; Galí and Gertler, 1999). In this case parameter ω can be interpreted as the share of economic agents whose expectations are consistent with the unbiasedness property of the rational expectations hypothesis, while the remaining share of agents, $1 - \omega$, form expectations in the backward-looking (static) manner. Finally, lagged inflation in the HNKPC can be independent of the heterogeneity of expectations' formation, reflecting rather indexation of wages and prices (Christiano *et al.*, 2005)

Both versions of the New Keynesian Phillips Curve have become the workhorses of empirical modeling of inflation. They have also provoked intense academic debates. It is not the aim of this study to provide the overview of this dis-

[2] In the original version of the NKPC the real marginal cost is the measure of economic slack. Under particular assumptions real marginal costs can be substituted with the output gap (Rotemberg and Woodford, 1999; Sbordone, 2002). In empirical applications, there are, however, different variables that proxy the excess demand in the economy.

cussion, especially given that comprehensive literature reviews exist (e.g. Nason and Smith, 2008; Mavroeidis *et al.*, 2014; Abbas *et al.*, 2016). Instead in this section we are going to present the studies that constitute the most important benchmarks for our analysis. However, it should be mentioned that a large part of the debate concerning the NKPC has been focused on the ways of measuring key variables included in this relationship, especially the real marginal costs and inflation expectations. Being aware of pros and cons of different choices in this respect, in this study we apply the agnostic approach, estimating the NKPC with the use of different measures of excess demand and inflation expectations. In the area of measuring inflation expectations we relax the assumption of rational expectations and make use of survey measures of inflation expectations. Although this approach is not micro-founded, it has been applied successfully in many empirical studies (e.g. Henzel and Wollmershäuser, 2006; Paloviita, 2008; Forsells and Kenny, 2010).

As mentioned in the introduction, price developments following the collapse of the Lehman Brothers have displayed two puzzles that are analyzed in empirical literature. The first one is the missing disinflation puzzle in 2009–2011. Despite large increases in unemployment during the Great Recession, inflation in advanced economies did not fall as much as past experiences would have predicted. This puzzle in part can be caused by the flattening of the Phillips curve – the phenomenon resulting both from the globalization, i.e. increased role of foreign output gap and decreased role of domestic output gap in influencing prices (Borio and Filardo, 2007), as well as from a more credible monetary policy, leading to more firmly anchored inflation expectations (Bernanke, 2010; Kuttner and Robinson, 2010). There are also other explanations of the missing disinflation puzzle, including the observation that the rise in unemployment during the Great Recession was structural, i.e. it translated to wages and prices less than in the past (IMF, 2013) and the findings of increased downward wage rigidities in the recession (Daly and Hobijn, 2014).

It is worth focusing on one of the studies analyzing in detail the missing disinflation in the U.S. economy, i.e. on the influential article by Coibion and Gorodnichenko (2015) that noticeably inspired the research presented in this study. The authors analyze the phenomenon of missing disinflation in 2009–2011 with the use of expectations-augmented Phillips curve. They show that none of the traditional explanations appear sufficient to describe inflation developments during the Great Recession. The anchored expectations hypothesis (Bernanke, 2010) can explain only a part of the missing disinflation. Explanations based on the labor market performance mentioned above imply that the missing disinflation in prices should have been accompanied by the missing disinflation in wages, which is not confirmed by the data. Also, the effects of the flattening of the Phillips curve seem insufficient to explain much of the missing disinflation. Instead of concluding that from this perspective the Phillips curve is useless for explaining inflation performance during the period under consideration, Coibion and Gorodnichenko (2015) propose another explanation. They show that the expectations-augmented Phillips curve, in which Michigan survey measures of

households' inflation expectations are used, can account for the absence of strong disinflationary pressures in 2009–2011. It is due to the fact that contrary to inflation forecasts of professional forecasters, whose expectations were relatively stable, household inflation expectations experienced a sharp rise, going from 2.5% in 2009 to 4% in 2013. This increase was caused by developments in oil prices, rising sharply since 2009. This explanation, quantitatively the most successful in capturing the absence of disinflation within the Phillips curve framework, goes in the opposite direction to Bernanke's anchored expectations hypothesis. Coibion and Gorodnichenko (2015) argue that unanchored household inflation expectations, treated as the adequate proxy for firms' inflation expectations, prevented the U.S. economy from deflation.[3] The authors conclude that while anchored inflation expectations remain desirable in most circumstances, the experience since 2009 presents a cautionary example of the potential downside of fully anchored expectations.

The second study that influenced the direction of research presented in this study is the analysis by Constâncio (2015), based on the results of the ESCB Low Inflation Task Force.[4] It aims at explaining excessive disinflation puzzle in the euro area economy after 2012. Even if low inflation rates in recent years can be driven by a decline in oil prices, it is not the complete explanation given that core inflation measures have also been below average in the euro area and in other developed economies. A part of research is based on the hybrid New Keynesian Phillips Curve, estimated with different proxies for the economic slack and inflation expectations. Constâncio (2015) shows that several specifications of the HNKPC are able to track recent disinflation. These models tend to be those that use the unemployment rate or unemployment gap and short- to medium-term measures of inflation expectations. In addition the study discusses stability of the Phillips curve, supporting evidence on the steepening of the Phillips curve in recent years.[5] This effect seems especially marked in the economies that experienced deeper and longer recessions and made greater efforts to reform their product and labor markets, with an impact on nominal rigidities. The natural question that arises in this respect is to what extent the steepening of the Phillips curve can signal inflation expectations becoming unanchored. Empirical studies indicate subtle signs of de-anchoring of inflation expectations in the euro area (e.g. Łyziak and Paloviita, 2016).

However, there are other explanations of the recent steepening of the Phillips curve in the euro area. Riggi and Venditti (2015) claim that it can result either

[3] This assumption seems debatable. Bryan *et al.* (2015) indicate that US firms' inflation expectations are very similar to the predictions of professional forecasters, despite a somewhat greater heterogeneity of expectations. Similar conclusions apply also in the case of Poland (e.g. Łyziak, 2013).

[4] The results collected by the Low Inflation Task Force will be presented in detail in the report forthcoming in the ECB Occasional Papers.

[5] Oinonen and Paloviita (2014) estimate time-varying parameters for the hybrid New Keynesian Phillips Curve In the euro area, using different proxies for the output gap. They show that the slope of the Phillips curve has become steeper after 2012.

from lower nominal rigidities due to structural reforms in stressed countries or from a decrease in strategic complementarities in price setting, related to a fall in the number of firms in the economy after the Great Recession. Another possibility taken into account is the increase of the frequency of price adjustments, but empirical studies on this issue has provided mixed results so far.

This study aims at contributing to empirical literature using the Phillips curve to explain price developments in the Polish economy. Kokoszczyński *et al.* (2010) show that survey-based measures of consumer inflation expectations are useful in estimating the hybrid New Keynesian Phillips Curve in Poland and in the Czech Republic. However, according to their estimates, the backward-looking component in this relationship is stronger than the forward-looking one, independently of the measure of inflation expectations used. Hałka and Kotłowski (2014) estimate the Phillips curves in the disaggregated manner, i.e. for individual price indexes. They find that more than 55% of the categories react to the output gap (mainly services and nondurable goods), while more than one-third of prices respond to exchange rate movements (mainly durable and semi-durable goods). At the same time globalization process makes only a small share of prices of durable and semi-durable goods react to domestic demand.[6] Even if the specification of the Phillips curves used by Hałka and Kotłowski (2014) does not include forward-looking elements, the results of their analysis suggest that the concept of the open-economy NKPC can be useful in analyzing price developments in Poland. Łyziak (2016) uses rational expectations and survey-based measures of inflation expectations of various groups of economic agents in estimating the small stylized New Keynesian model of monetary policy with Polish data. Estimation results show that with survey-based measures the expectation term in the NKPC becomes significantly larger than in the model with rational expectations, although in all the cases the role of lagged inflation is somewhat stronger than the role of expected inflation. Survey-based measures of inflation expectations of Polish consumers, financial sector analysts and, particularly, enterprises, contain forward-looking information that improves forecasting properties of the New Keynesian model relative to its type with rational (model-consistent) expectations. Inflation expectations of enterprises seem the most powerful in this respect.

2. METHODS AND DATA

Before analyzing recent inflationary developments in Poland with the use of the New Keynesian Phillips Curve we consider the drivers of deflationary episodes in different economies to answer the question whether the Polish deflation is surprising taking them into account. In this respect, we use the Deflation Vulnerability Index (DVI)

[6] In their recent paper Hałka and Kotłowski (2016) deepen the analysis of the global determinants of domestic inflation in Sweden, Poland and Czech Republic. They find that the low inflation in those countries results not only from favourable shock to commodity prices, but is also due to weak demand, both internal and external. Moreover, they show that since the beginning of financial crisis the role of demand shocks affecting inflation was more pronounced than the role of supply shocks.

proposed by Kumar *et al.* (2003), that combines determinants found to lead deflationary episodes in different economies. The index reflects developments in aggregate prices, economic activity, asset markets, and credit and financial markets. In the above groups there are 11 specific indices considered, each of them of binary nature, with a value 1 reflecting possible deflationary pressure from a given source and otherwise the value of zero. Subsequent components of the index equal 1 if: (1) annual inflation, measured as a change in the CPI, is less than 0.5%; (2) annual inflation, measured as a change in the GDP deflator, is less than 0.5%; (3) annual inflation, measured as a change in the core CPI, is less than 0.5%; (4) the output gap has widened by more than 2 percentage points over the last 4 quarters; (5) the output gap is less than –2%; (6) the real GDP growth over the last 3 years is less than annual average growth over the preceding decade; (7) the broad measure of the stock market over the last 3 years has fallen by more than 30%; (8) the real effective exchange rate has appreciated by more than 4% over the last 4 quarters; (9) the private nominal credit growth is less than nominal GDP growth over the last 4 quarters; (10) the cumulative private nominal credit growth over the past 3 years is less than 10%; (11) the broad money (M3) growth on a y/y basis has grown slower than base money by 2 percentage points (or less) over the last 8 quarters.

To estimate the hybrid New Keynesian Phillips curve models for Poland we take into consideration different variables that proxy inflation developments, inflation expectations, economic slack and imported inflation. According to the notation applied, the model i_k_m_h denotes the HNKPC specification, in which we use the *i*-th measure of inflation as the dependent variable and among explanatory variables there are: the *k*-th measure of the economic slack, the *m*-th measure of inflation expectations and the *h*-th measure of imported inflation.

We use two measures of consumer price changes in Poland ($\pi^{(i)}$), i.e. the annualized rate of growth of the overall Consumer Price Index, CPI ($i = 1$) or annualized the core inflation that excludes foodstuffs and energy items ($i = 2$).

There are six measures of the economic slack ($y^{(k)}$) considered in this study. The first one is given by the output gap estimated with the use of the Hodrick-Prescott (HP) filter ($k = 1$). The second measure of the economic slack ($k = 2$) is a transformed version of the HP-filter output gap, capturing potential non-linear effects of the excess demand on inflation in the periods, when the output gap is positive. This transformation, proposed by Alichi *et al.* (2009), has the following form:

$$\hat{y}_t^{(2)} = \begin{cases} \dfrac{\hat{y}^{\max}}{\hat{y}^{\max} - \hat{y}_t^{(1)}} \cdot \hat{y}_t^{(1)} \; for \; \hat{y}_t^{(1)} > 0 \\ \hat{y}_t^{(1)} \; for \; \hat{y}_t^{(1)} \leqslant 0 \end{cases} \tag{3}$$

The remaining measures of the economic slack comprise the output gap obtained with Christiano-Fitzgerald (CF) filter ($k = 3$), asymmetric CF-filter output gap transformed in the way proposed by Alichi *et al.* (2009) ($k = 4$),

a deviation of the real GDP growth rate from its mean ($k = 5$) and the inverse of the unemployment rate gap, estimated with the HP filter ($k = 6$).[7]

Inflation expectations ($\pi^{e(m)}$) are proxied with the following measures: cumulative mean of CPI inflation ($m = 1$), NBP inflation target ($m = 2$) as well as with survey-based measures of short-term (12 months ahead) inflation expectations of enterprises ($m = 3$), financial sector analysts ($m = 4$) and consumers ($m = 5$).[8]

Finally, we use two proxies reflecting imported inflation ($\pi^{f(h)}$), i.e. annualized growth rate of import prices ($h = 1$) and the real effective exchange rate gap, calculated with the HP filter ($h = 2$).

The general form of the estimated hybrid version of the NKPC in the case of the model i_k_m_h is the following:

$$\pi_t^{(i)} = c_1\pi_{t-1}^{(i)} + c_2\pi_t^{e(m)} + c_3\hat{y}_{t-l^y}^{(k)} + c_4\pi_{t-l^f}^{f(h)} + \varepsilon_t \tag{4}$$

where the lags of the output gap (l^y) and of the foreign component (l^f) are selected on the basis of statistical fit (in the estimated equations they equal 0 or 1).

We estimate the Phillips curves using two sample periods. Both of them start in 2003Q1, while they end either in 2015Q3 (full sample period) or in 2011Q4, i.e. before the recent disinflation started (short sample period). Checking stability of the Phillips curve during the period of recent disinflation we compare the estimated short-run coefficients as well as the long-run impact of inflation expectations, economic slack and foreign prices on domestic inflation, given by the respective coefficients: $\frac{c_2}{1-c_1}$, $\frac{c_3}{1-c_1}$ and $\frac{c_4}{1-c_1}$. We also pay attention to long--run intercepts, given by the following expression: $\frac{c_2}{1-c_1}\overline{\pi}_t^{e(m)} + \frac{c_4}{1-c_1}\overline{\pi}_t^{f(h)}$, where $\overline{\pi}_t^{e(m)}$ denotes the average value of the m-th measure of inflation expectations, while $\overline{\pi}_t^{f(h)}$ denotes the average value of the h-th measure of imported inflation in a given sample period.

Estimating the equations we do not impose dynamic homogeneity – the property that makes the Phillips curve vertical in the long run. This condition is, however, verified empirically with the Wald test. If the openness of the economy is represented by the real exchange rate gap, the dynamic homogeneity property is given by the condition: $c_1 + c_2 = 1$, while in the case of using annualized rate of growth of import prices – by the condition: $c_1 + c_2 + c_4 = 1$.

The HNKPC models contain unobservable variables – inflation expectations and economic slack – that can be subject to measurement errors. In such circumstances the overall error of the equation becomes a combination of an exogenous

[7] In the cases of both measures of the output gap based on Alichi *et al.* (2009) concept, different values of $\hat{y}^{\max}$ were tested. Finally, the best statistical fit of HNKPC models was obtained for $\hat{y}^{\max}$ equal 0.05.

[8] Survey-based measures of inflation expectations are the same as used in Łyziak (2016).

shock and the measurement error of explanatory variables. For this reason we estimate Phillips curves using the Generalized Method of Moments (GMM). We use lagged values of explanatory variables as instruments, which seems a common choice in the literature (Nason and Smith, 2008).

3. RESULTS

Recent disinflation and ongoing deflation in Poland were largely unexpected and are perceived mainly as the result of a fall in commodity prices. The Deflation Vulnerability Index (DVI) introduced by Kumar *et al.* (2003) and used by IMF in assessing deflationary risks in different economies[9], allows analysing a range of potential causes of deflation, in particular the demand factors.

Figure 4 presents DVI calculated for Poland compared with CPI inflation. Both series are fairly correlated with each other – the Pearson correlation coefficient equals –0.65, while the Spearman rank correlation coefficient approaches –0.54.[10] It seems, therefore, that the index contains some information about price developments. Analyzing its sub-components we can observe that recently deflationary risks have been caused not by a single factor, i.e. positive supply shock exerting downward pressure on prices but also by other factors, i.e. by developments in the real economy and in credit and money aggregates. During the latest disinflation that started in 2012 Deflation Vulnerability Index increased considerably and recently it has been close to 0.5, signaling – according to classification introduced by Kumar *et al.* (2003) – moderate or almost high deflationary risks.[11]

Given its high correlation with actual inflation, it seems that DVI can be a useful tool in analyzing inflation perspectives in Poland. It also indirectly suggests that the Hybrid New Keynesian Phillips Curve, putting emphasis on the role of economic slack in determining inflation, can be an adequate theoretical concept in explaining recent price developments. In addition, it considers inflation expectations that are not used in calculation of the Deflation Vulnerability Index.

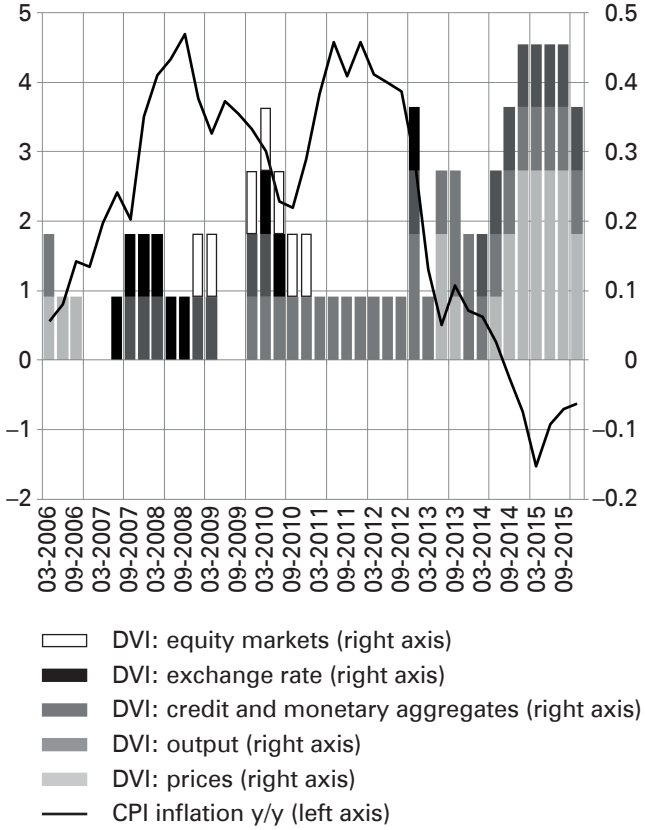
With the diversity of variables used in the estimation of the HNKPC models, in each of the sample periods under consideration there are 120 equations estimated – half of them in terms of the CPI inflation and another half of them in terms of core inflation. Detailed estimation results are presented in the Annex (Table 3, Table 4). Summarizing them, it should be noted firstly that, in general, the theoretical specification of the HNKPC is supported empirically. In a dominant part of estimated equations, both past inflation and inflation expectations are needed to explain current inflation. Taking into account the full sample

[9] E.g. IMF (2014), p. 14.

[10] In the period after the collapse of Lehman Brothers, correlation of CPI inflation and DVI is even larger – Pearson and Spearman correlation coefficients equal –0.78 and –0.83, respectively.

[11] According to Kumar *et al.* (2003), minimal deflation risk appear when DVI is smaller than 0.2; small deflation risk – if it is between 0.2 and 0.3, moderate – for DVI between 0.3 and 0.5, while high – for DVI above 0.5.

Figure 4. Deflation Vulnerability Index (DVI) and its subcomponents vs. CPI inflation in Poland (year-on-year changes, %)



Notes: Bars display Deflation Vulnerability Index calculated for Poland in line with IMF method (Kumar et al., 2003) and its components. Minimal deflation risk appear when DVI is smaller than 0.2; small deflation risk – if it is between 0.2 and 0.3, moderate – for DVI between 0.3 and 0.5, while high – for DVI above 0.5.

Source: own calculations based on GUS, NBP, OECD and BIS data, GUS.

period (2003–2015), past inflation is statistically insignificant only in 20% of models estimated in terms of CPI inflation and in 13% of models estimated in terms of core inflation. For shorter period of estimation (2003–2011) that excludes the recent disinflation, respective shares are 45% and 8%. It would suggests that recently CPI inflation has become more persistent, which does not apply for core inflation. We will analyze this issue in the final part of this section, comparing estimated coefficients in both sample periods. Here we can conclude that the hybrid version of the NKPC is confirmed empirically in Poland more often than

the traditional NKPC. It is in line with the results for European economies reported in the literature.[12]

Analyzing estimation results we observe that the problems with incorrect signs of different coefficients or statistical insignificance of explanatory variables are not very frequent (Table 2). The share of HNKPC models that display inconsistencies of this kind amounts approximately to 28% in the full sample and to 17% in the shorter sample period. This share is larger for core inflation than for CPI inflation. Insignificant output gap while explaining core inflation or insignificant foreign inflation constitute the major sources of these problems.

Table 2. Share of HNKPC models whose estimation results are inconsistent (in %)

	CPI inflation		Core inflation	
	2003–2015	2003–2012	2003–2015	2003–2012
c_1 negative and significant	0.0	1.7	0.0	0.0
c_2 negative or insignificant	1.7	1.7	11.7	5.0
c_3 negative or insignificant	5.0	6.7	20.0	10.0
c_4 negative or insignificant	11.7	10.0	10.0	5.0
Share of inconsistent HNKPCs	**16.7**	**15.0**	**40.0**	**18.3**

Source: own calculations.

The results of the Hansen *J*-test show that for all the estimated models, the null hypothesis of valid overidentifying restrictions cannot be rejected.

Dynamic homogeneity property, making the Phillips curve vertical in the long run, is displayed more often in the short sample period than in the long one, and more frequently for CPI inflation than core inflation. Using the sample period 2003–2012, approximately 78% of estimated equations specified in terms of CPI inflation compared to 32% of those specified in terms of core inflation met dynamic homogeneity condition. For the full sample period, 2003–2015, respective numbers reach 80% and 12%. The fact that Phillips curves specified in terms of CPI inflation are vertical in the long run more frequently than those specified in terms of core inflation can be explained by the fact that empirical proxies of inflation expectations used in this study are not consistent with core inflation – both survey-based measures of inflation expectations as well as the NBP inflation target refer to headline inflation, not to core inflation.

Detailed analysis of estimated HNKPC models conducted in the subsequent part of this section takes into consideration only those specifications that do not

[12] E.g. Paloviita (2008), using pooled European data, shows that the purely forward-looking NKPC is clearly outperformed by the New Classical and Hybrid New Keynesian Phillips curves.

display inconsistencies described in Table 2. We aim at assessing, first, what combination of proxies for inflation expectations, economic slack and imported inflation guarantee the best statistical fit of the estimated HNKPC, second, which specifications are the most successful in modeling the recent disinflation, third, what changes in estimated coefficients occur during the recent disinflation period.

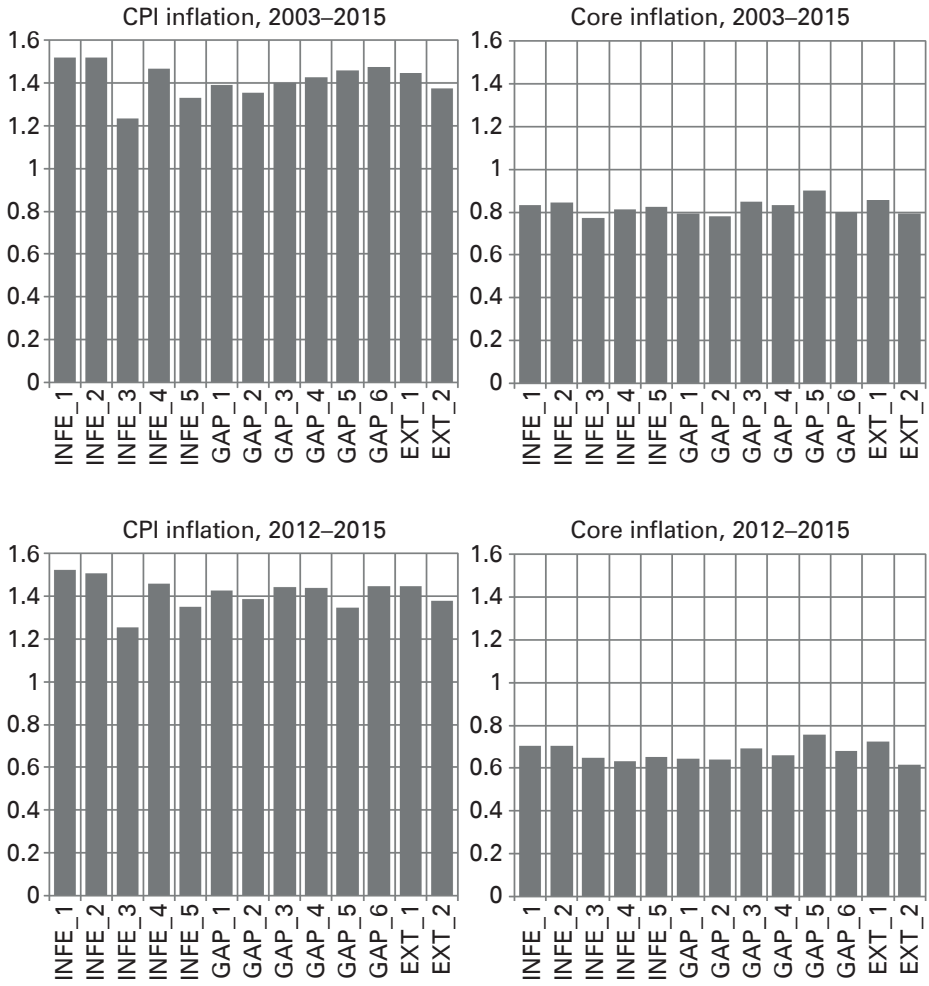
Taking into account the results based on the full sample period (2003–2015) we observe that Phillips curves estimated in terms of core inflation display lower Root Mean Squared Errors, RMSE (0.80), than Phillips curves estimated with CPI inflation as the explanatory variable (1.42). The same applies to analogous measures of errors calculated for the period of recent disinflation (2012–2015) which equal 0.66 and 1.42, respectively.

The selection of the price index and particular proxies for determinants of inflation in the Phillips curve have a significant influence on statistical fit of estimated models, especially those in which headline inflation is the explanatory variable. Figure 5 presents errors of the estimation (differences between fitted and actual values) in the form of Root Mean Squared Errors – both for the whole sample used in the estimation (2003–2015) and during the recent disinflation (2012–015). It can be seen that minimal RMSE corresponds to models in which survey-based measures of inflation expectations of enterprises are used. This conclusion is consistent with previous findings, based on the small structural New Keynesian (NK) model, showing that enterprises' inflation expectations are the most relevant from the macroeconomic perspective and used in the NK model improve significantly its forecasting accuracy (Łyziak, 2016). In the present results there is only one exception from this observation, i.e. analyzing errors in the recent period (2012–2015) of the Phillips curve estimated in terms of core inflation. In this case, using survey-based measures of financial analysts' inflation expectations minimizes the forecasting errors during the disinflation period, however models with enterprises' inflation expectations produce only slightly less favorable outcomes.

The best-performing measure of the economic slack is given by the Alichi *et al.* (2009) transformed version of the HP-filter output gap that captures non-linear effects of the excess demand on inflation in the periods, when the output gap is positive. It suggests that the Phillips curve in Poland displays some asymmetry and that prices are more responsive to the output gap when it is highly positive. It corresponds to findings by Sznajderska (2014), who shows stronger responses of quarter on quarter CPI inflation to output gap when it is positive. However, it should be noted that the differences in statistical fit between HNKPC models using standard version of the HP-filter output gap and the measure proposed by Alichi *et al.* (2009) are very small, especially for models in which core inflation is explanatory variable.

Finally, it seems that both during the whole sample period and during the recent disinflation the real exchange rate gap is a better proxy for foreign component of domestic CPI and core inflation than the rate of growth of import prices.

Figure 5. Root Mean Squared Errors (RMSE) of HNKPC models estimated on the sample 2003–2015

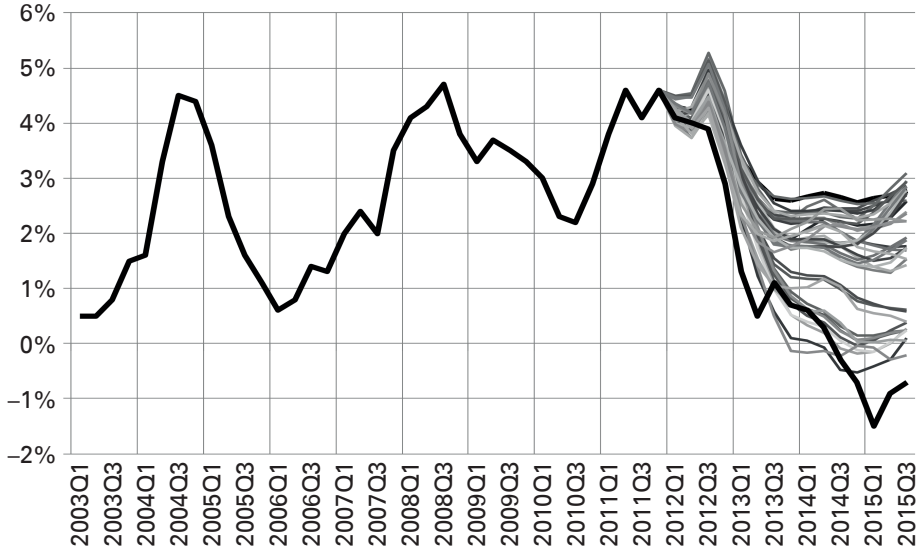


Notes: Symbols *INFE_m* denote subsequent measures of inflation expectations, *GAP_k* – subsequent measures of the economic slack, while *EXT_h* – subsequent measures of imported inflation used in the study.

Source: own calculations.

The above exercise was based on the HNKPC models estimated on the full sample. However, from the empirical point of view it is more relevant to assess out-of-sample properties of those models. To do this we estimate Phillips curves on the shorter sample period, that finishes before the beginning of the recent disinflation. Then we generate forecasts of inflation for the disinflation period

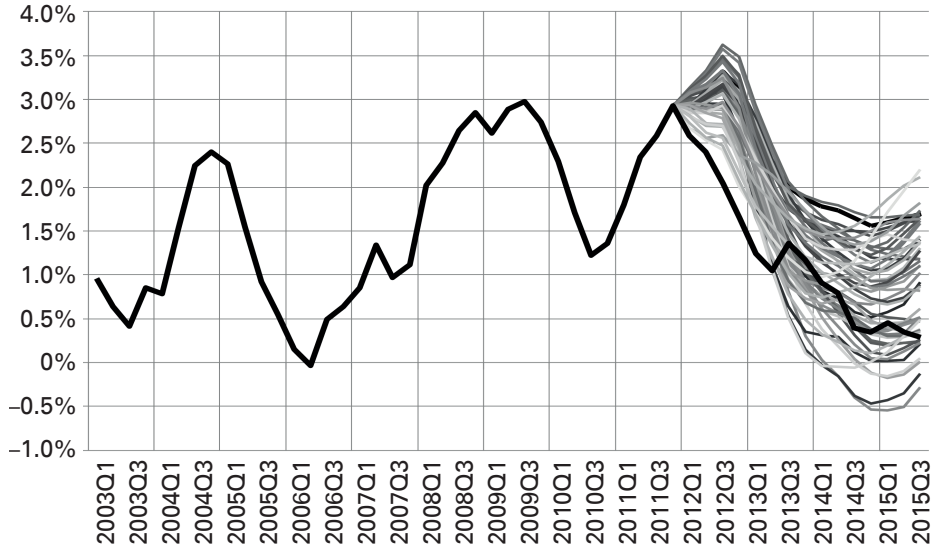
Figure 6. CPI inflation (year-on-year) forecasts for 2012–2015 based on HNKPC models estimated on the sample 2003–2011



Notes: HNKPC models generate forecasts in terms of annualized CPI inflation that were transformed into forecasts of year-on-year core inflation.

Source: own calculations.

Figure 7. Core inflation (year-on-year) forecasts for 2012–2015 based on HNKPC models estimated on the sample 2003–2011



Notes: HNKPC models generate forecasts in terms of annualized core inflation that were transformed into forecasts of year-on-year core inflation.

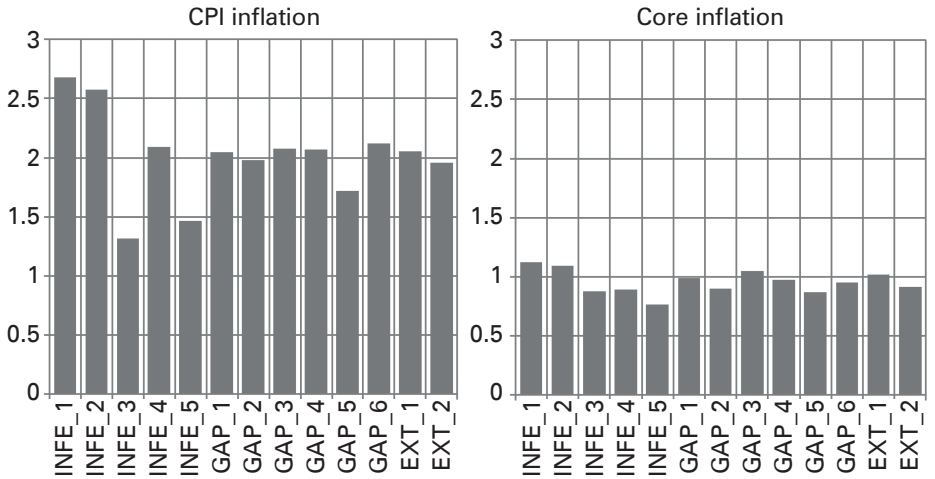
Source: own calculations.

(2012–2015) and assess out-of-sample forecasting properties of different Phillips curves.

Paths of inflation forecasts generated on the basis of HNKPC models estimated on the sample 2003–2011 (Figure 6, Figure 7) suggest that those models do not replicate adequately the recent disinflation period, especially in the case of models explaining CPI inflation. Firstly, even if those models seem to anticipate a fall in CPI inflation, they are not able to predict the scale of deflation in 2015 – all the CPI forecasts remain above the actual CPI inflation in 2015. Secondly, in the case of core inflation, paths of its forecasts surround the actual figures – there are some specifications that reflect the actual developments of core inflation and some that predict even deeper deflation. However, majority of forecasts is above the actual core inflation. Thirdly, independently of the inflation measure used a large number of specifications predict increase of inflation in the most recent period (i.e. in 2015), while actual price developments are clearly at odds with this prediction.

What is the model specification that makes the paths of inflation forecasts closest to actual figures? Analysis of Root Mean Squared Errors (RMSE) of inflation forecasts confirms that for both headline and core inflation this specification should use asymmetrical measure of the HP-filter output gap and the real exchange rate gap. It should be emphasized that the deviation of real GDP growth rate from its mean represents another proxy for the economic slack improving inflation forecasts. As far as the measure of inflation expectations is

Figure 8. Root Mean Squared Errors (RMSE) of inflation out-of-sample forecasts for 2012-2015 based on HNKPC models estimated using the sample 2003-2011



Notes: HNKPC models generate forecasts in terms of annualized CPI inflation that were transformed into forecasts of year-on-year core inflation.

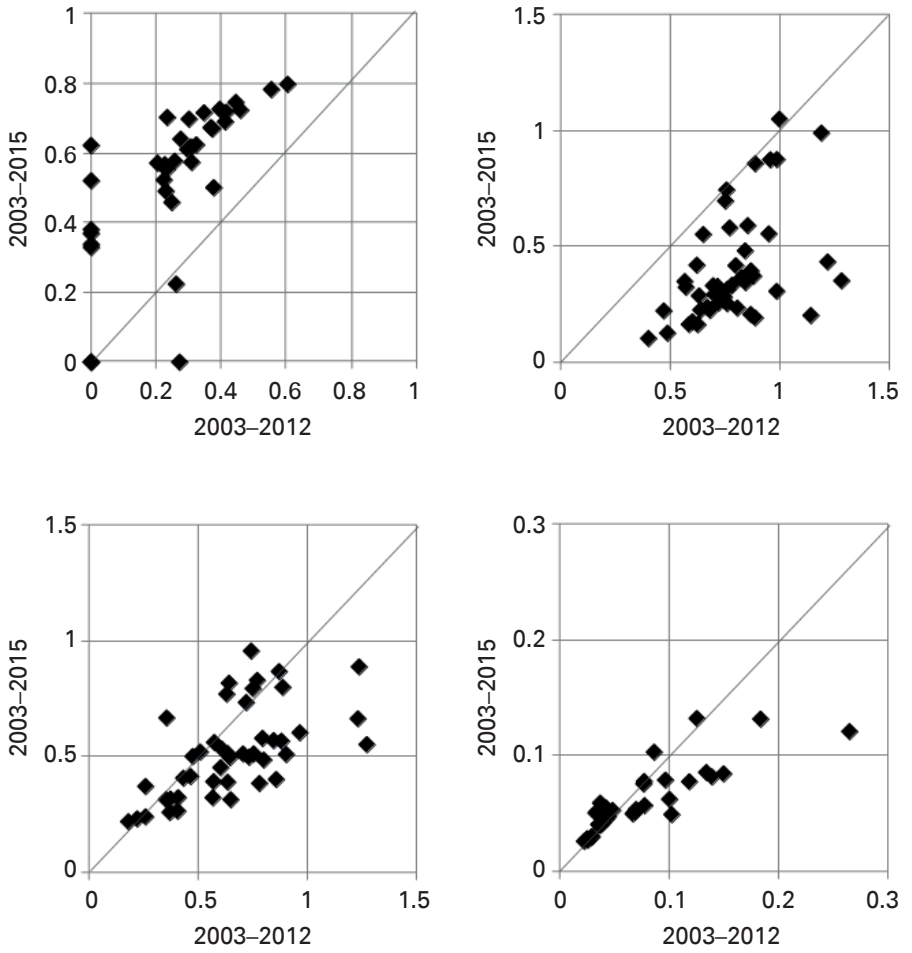
Source: own calculations.

concerned, the models that generate relatively accurate CPI inflation forecasts are those that use enterprises' inflation expectations, while in the case of core inflation forecasts consumer inflation expectations seem more adequate.

Limited ability of the Phillips curve models to predict the recent disinflation leads to the question to what extent the estimated coefficients are different between the models estimated on the full sample (2003–2015) and on the short sample (2003–2011). The results of such inspection depend on the measure of inflation used as explanatory variable.

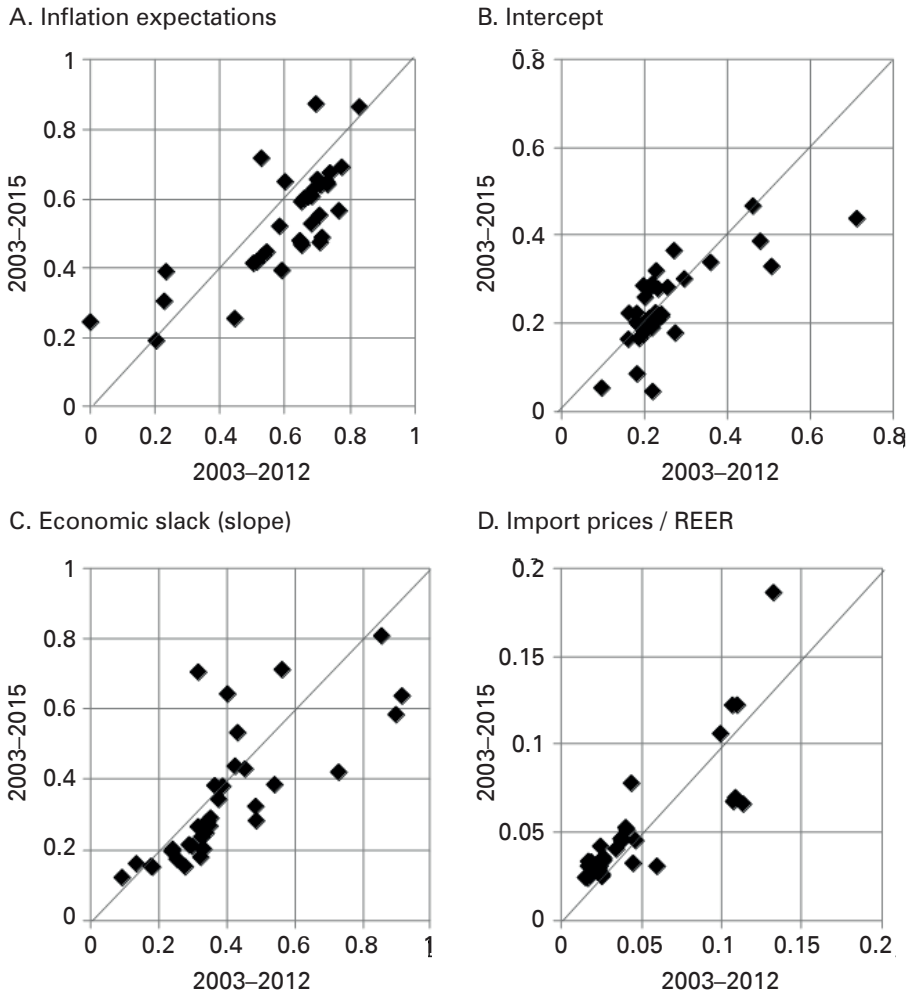
Analyzing directly estimated, short-run coefficients (Figure 9, Figure 10) we observe that in the case of HNKPC models specified in terms of CPI inflation in a dominant part of models inflation persistence becomes larger in the longer

Figure 9. Stability of the HNKPC, CPI inflation, short-run coefficients



Source: own calculations.

Figure 10. Stability of the HNKPC, core inflation, short-run coefficients

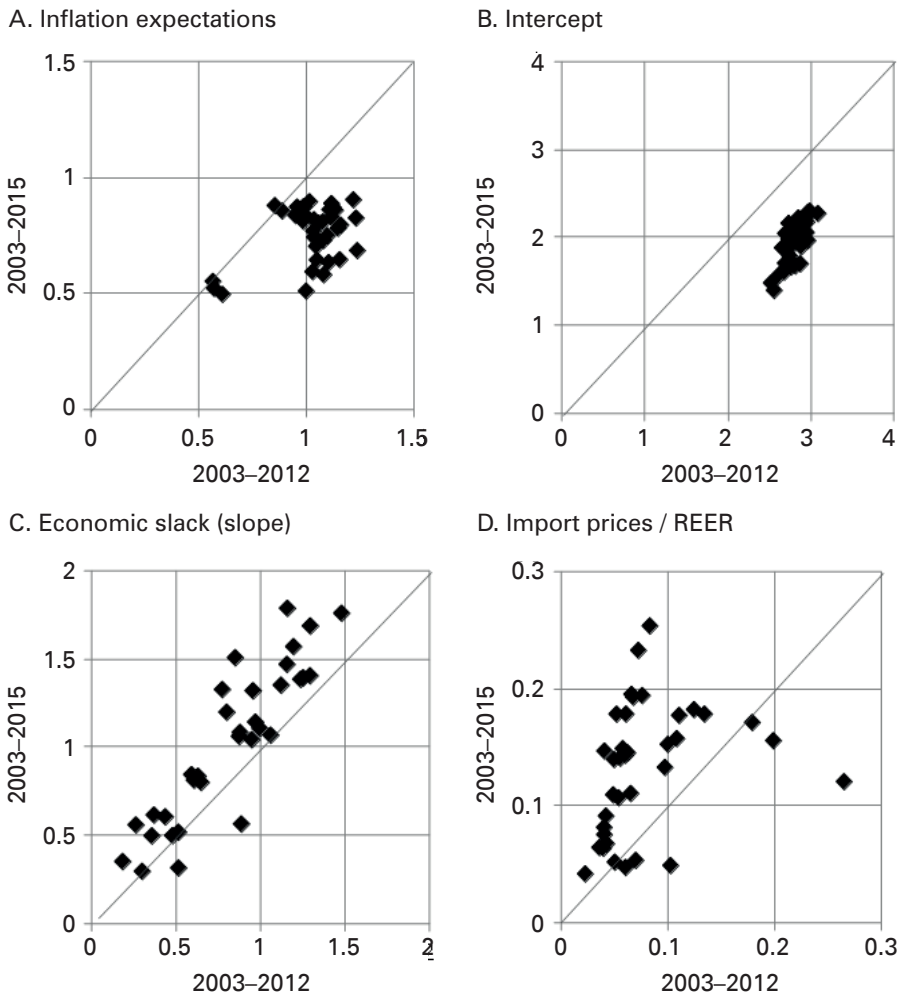


Source: own calculations.

sample, covering the recent disinflation. At the same time the impact of other factors, i.e. inflation expectations, economic slack and foreign inflation, is reduced. The results based on core inflation models are more mixed. Majority of them suggest that inflation persistence and the role of inflation expectations have been reduced recently, similarly as the impact of the economic slack on price developments. All at once the impact of foreign inflation on the domestic one has become stronger. However, in the case of each of those coefficients there are also models indicating opposite changes.

Analyzing long-run coefficients (Figure 11, Figure 12), it can be noted that independently of the measure of inflation, the role of inflation expectations has

Figure 11. Stability of the HNKPC, CPI inflation, long-run coefficients

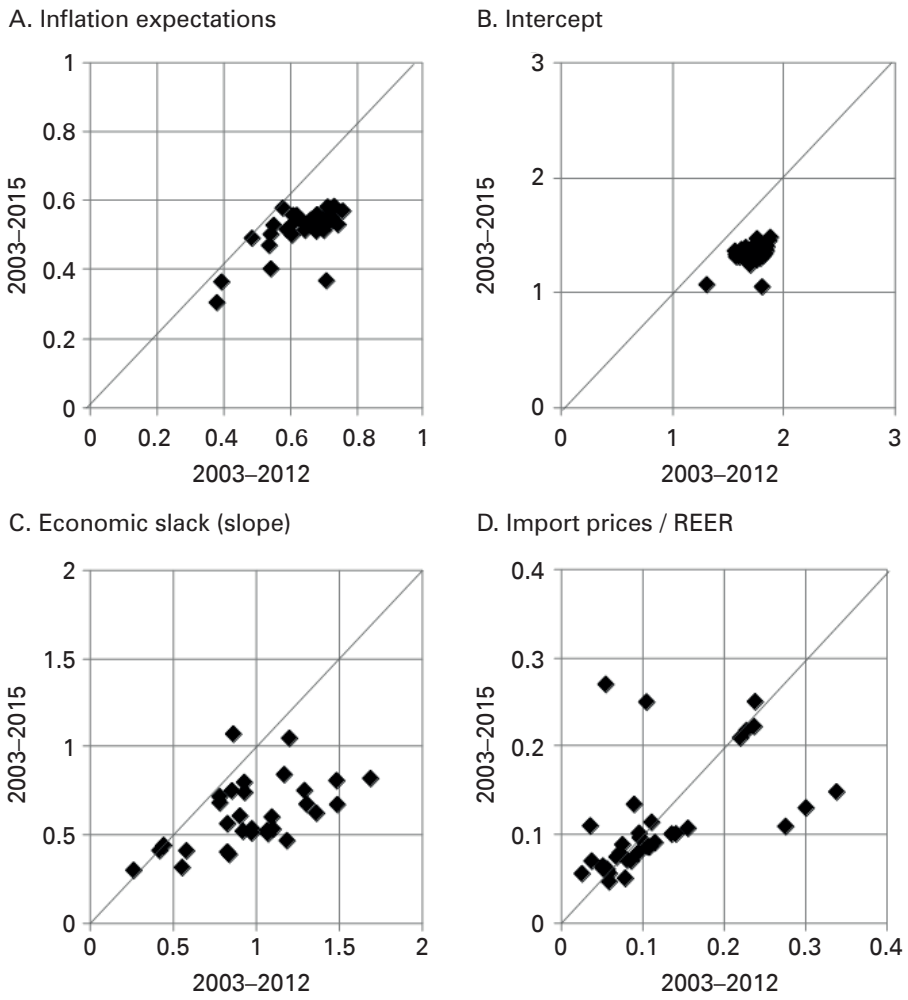


Source: own calculations.

been reduced in the recent period. In addition, the intercepts in all the specification have diminished, indicating de-anchoring of inflation expectations, which have recently reached their historical lowest levels. A dominant part of CPI inflation models indicate steepening of the Phillips curve and increased role of foreign inflation in determining domestic price changes, while in the case of core inflation models we rather observe a reduced impact of economic slack and foreign price changes on domestic inflation.

Being aware of the fact that changes in the coefficients of HNKPC models estimated in terms of headline inflation can be biased due to the fact that this measure of inflation has been strongly influenced by food and energy prices in

Figure 12. Stability of the HNKPC, core inflation, long-run coefficients



Source: own calculations.

the recent period, it seems that analyzing stability of the Phillips curve we should rely rather on core inflation models. In addition, conclusions based on those models are comparable with results of similar tests performed using euro area data that are based also on similar measures of core inflation. From this perspective, our analysis suggests some flattening of the Phillips curve in recent years, combined with a smaller impact of inflation expectations on actual inflation and the reduced long-run intercept. Flattening of the Phillips curve can be either perceived as a typical phenomenon in the downward stage of the business cycle or explained with increasing openness of the Polish economy, making foreign demand an important determinant of domestic price developments.

To sum up, it seems that the recent disinflation and a prolonged period of deflation in the Polish economy resulted from a combination of global and domestic factors. The HNKPC seems a useful concept capable of explaining recent price developments, especially in the case of core inflation. Our analysis suggest that to fit the actual data survey-based measures of enterprises inflation expectations should be used, however, in some tests consumer inflation expectations perform even better than enterprises' expectations. In addition, capturing asymmetric effects of output gap on inflation – stronger when the output gap is positive – improves statistical fit of HNKPC models.

On the other hand, we show that the Phillips curve relationship has not been stable recently. In particular, it seems that core inflation has become less sensitive to economic slack and to inflation expectations, while the long-run intercept has been reduced. The latter factor, combined with the flattening of the Phillips curve, suggests that the return of inflation to levels consistent with the NBP inflation target can take more time than it would based on models estimated with pre–2012 data.

4. CONCLUSIONS

The prolonged period of deflation in Poland was not expected, however, it does not seem entirely puzzling. Firstly, standard factors signaling deflation risks, embodied in the Deflation Vulnerability Index – especially those related to inflation performance, economic activity and credit and monetary aggregates – seem informative in the context of Polish deflation. Secondly, the concept of the Hybrid New Keynesian Phillips Curve seems useful in analyzing price developments in Poland, however, the degree of this usefulness is conditional on proxies for explanatory variables applied. In line with previous studies, based both on Polish and external experiences, survey-based measures of inflation expectations – particularly enterprises' inflation expectations – seem to be an important factor needed to understand recent price developments. Thirdly, to adequately reflect cyclical component of inflation one should take into account either the transformed output gap measure, making inflation more responsive to output gap when it is highly positive, or the growth rate of real GDP relative to its mean. The recent disinflation, analyzed through the lenses of the HNKPC models, was caused by a combination of different factors, including: lowering of commodity prices and import prices, reduced level of inflation expectations and inflation as well as a negative output gap.

Analyzing stability of the Phillips curve we find signs of its flattening in recent years. It applies to the models estimated in terms of core inflation, while CPI inflation models suggest rather a steepening of the Phillips curve. Both types of models agree on the weakening of the link between inflation expectations and actual inflation as well as on the reduction of the long-run intercept.

The Phillips curve in Poland is alive. We can use it to explain past inflationary performance and to predict its changes, at least to some extent.

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ANNEX

Table 3. Estimation results of the HNKPC, 2003–2015

Model *i_k_m_h*	c_1	c_1-prob	c_2	c_2-prob	c_3	c_3-prob	c_4	c_4-prob	J-stat	J-prob	R^2adj	Dyn. hom. F-prob.
1111	**0.717**	0.000	**0.235**	0.079	**0.314**	0.053	**0.040**	0.001	8.725	0.463	0.441	0.400
1112	**0.521**	0.000	**0.434**	0.003	**0.665**	0.009	**0.086**	0.046	9.091	0.429	0.491	0.436
1121	**0.719**	0.000	**0.225**	0.061	**0.323**	0.041	**0.040**	0.001	8.598	0.475	0.446	0.302
1122	**0.568**	0.000	**0.372**	0.004	**0.604**	0.011	**0.079**	0.053	8.729	0.463	0.485	0.268
1131	**0.194**	0.148	**0.745**	0.000	**0.317**	0.028	**0.047**	0.000	6.904	0.647	0.637	0.221
1132	–0.138	0.313	1.051	0.000	**0.795**	0.000	**0.132**	0.001	7.679	0.567	0.683	0.698
1141	**0.619**	0.000	**0.333**	0.017	**0.323**	0.020	**0.041**	0.000	8.760	0.460	0.494	0.354
1142	**0.459**	0.001	**0.482**	0.001	**0.580**	0.007	**0.084**	0.033	8.944	0.442	0.536	0.267
1151	**0.369**	0.033	**0.350**	0.002	**0.315**	0.018	**0.041**	0.001	8.162	0.518	0.554	0.000
1152	–0.140	0.349	**0.635**	0.000	**0.755**	0.000	**0.148**	0.000	9.280	0.412	0.669	0.000
1211	**0.671**	0.000	**0.258**	0.038	**0.265**	0.019	**0.027**	0.001	8.777	0.458	0.466	0.181
1212	**0.524**	0.000	**0.395**	0.004	**0.498**	0.007	**0.082**	0.057	8.698	0.466	0.495	0.212
1221	**0.691**	0.000	**0.226**	0.041	**0.259**	0.018	**0.028**	0.001	8.633	0.472	0.467	0.103
1222	**0.575**	0.000	**0.328**	0.006	**0.453**	0.011	**0.076**	0.073	8.409	0.494	0.486	0.120
1231	**0.224**	0.085	**0.697**	0.000	**0.232**	0.002	**0.040**	0.000	7.173	0.619	0.653	0.085
1232	**0.004**	0.978	**0.858**	0.000	**0.568**	0.001	**0.121**	0.007	7.471	0.588	0.693	0.284
1241	**0.611**	0.000	**0.316**	0.012	**0.240**	0.013	**0.029**	0.000	8.803	0.456	0.506	0.131
1242	**0.491**	0.001	**0.418**	0.002	**0.415**	0.013	**0.078**	0.059	8.485	0.486	0.528	0.134

1251	**0.381**	0.026	**0.324**	0.002	**0.219**	0.030	**0.026**	0.002	8.458	0.489	0.567	0.000
1252	–0.035	0.817	**0.553**	0.000	**0.535**	0.000	**0.132**	0.000	9.397	0.401	0.668	0.000
1311	**0.699**	0.000	**0.207**	0.142	**0.510**	0.002	**0.054**	0.001	7.716	0.563	0.427	0.139
1312	**0.637**	0.000	**0.321**	0.023	**0.631**	0.001	**0.057**	0.105	9.183	0.421	0.447	0.513
1321	**0.724**	0.000	**0.175**	0.140	**0.487**	0.001	**0.054**	0.001	7.751	0.559	0.422	0.084
1322	**0.691**	0.000	**0.247**	0.045	**0.560**	0.001	**0.051**	0.123	9.024	0.435	0.434	0.289
1331	**0.330**	0.053	**0.591**	0.003	**0.408**	0.037	**0.045**	0.000	9.311	0.409	0.618	0.136
1332	**0.108**	0.470	**0.876**	0.000	**0.521**	0.002	**0.049**	0.072	8.456	0.489	0.613	0.744
1341	**0.625**	0.000	**0.282**	0.058	**0.497**	0.001	**0.055**	0.000	7.700	0.565	0.467	0.097
1342	**0.578**	0.000	**0.365**	0.015	**0.562**	0.001	**0.059**	0.064	9.247	0.415	0.489	0.316
1351	**0.362**	0.081	**0.331**	0.015	**0.513**	0.003	**0.053**	0.000	7.750	0.559	0.537	0.001
1352	–0.009	0.962	**0.581**	0.000	**0.668**	0.000	**0.078**	0.001	9.846	0.363	0.624	0.001
1411	**0.703**	0.000	**0.192**	0.121	**0.402**	0.004	**0.053**	0.000	7.388	0.597	0.427	0.077
1412	**0.623**	0.000	**0.307**	0.027	**0.570**	0.000	**0.056**	0.084	9.110	0.427	0.455	0.232
1421	**0.727**	0.000	**0.163**	0.128	**0.385**	0.003	**0.053**	0.000	7.454	0.590	0.423	0.042
1422	**0.674**	0.000	**0.238**	0.050	**0.513**	0.001	**0.051**	0.096	8.950	0.442	0.443	0.113
1431	**0.338**	0.051	**0.555**	0.005	**0.372**	0.026	**0.042**	0.000	8.709	0.465	0.618	0.068
1432	**0.074**	0.618	**0.877**	0.000	**0.502**	0.000	**0.054**	0.087	8.458	0.489	0.615	0.461
1441	**0.641**	0.000	**0.253**	0.059	**0.391**	0.002	**0.054**	0.000	7.454	0.590	0.464	0.045
1442	**0.572**	0.000	**0.345**	0.019	**0.515**	0.000	**0.057**	0.059	9.188	0.420	0.493	0.118
1451	**0.422**	0.033	**0.287**	0.025	**0.392**	0.005	**0.050**	0.000	7.619	0.573	0.531	0.001
1452	**0.011**	0.953	**0.552**	0.000	**0.581**	0.000	**0.076**	0.000	9.731	0.373	0.623	0.000
1511	**0.784**	0.000	**0.126**	0.183	**0.869**	0.020	**0.050**	0.005	5.943	0.746	0.438	0.076

Table 3 (cont.)

1512	**0.776**	0.000	**0.144**	0.076	**0.762**	0.093	**0.035**	0.274	6.522	0.687	0.393	0.179
1521	**0.799**	0.000	**0.103**	0.220	**0.831**	0.024	**0.051**	0.004	5.944	0.746	0.430	0.046
1522	**0.788**	0.000	**0.123**	0.092	**0.701**	0.107	**0.033**	0.294	6.497	0.689	0.388	0.126
1531	**0.502**	0.000	**0.420**	0.001	**0.735**	0.032	**0.055**	0.001	5.938	0.746	0.573	0.071
1532	**0.413**	0.001	**0.526**	0.000	**0.825**	0.031	**0.041**	0.138	7.365	0.599	0.568	0.275
1541	**0.747**	0.000	**0.164**	0.121	**0.819**	0.023	**0.050**	0.004	5.878	0.752	0.462	0.063
1542	**0.737**	0.000	**0.175**	0.052	**0.698**	0.100	**0.036**	0.229	6.529	0.686	0.418	0.132
1551	**0.554**	0.000	**0.222**	0.010	**0.801**	0.012	**0.049**	0.005	5.940	0.746	0.533	0.000
1552	**0.457**	0.000	**0.293**	0.001	**0.772**	0.031	**0.050**	0.028	8.181	0.516	0.545	0.000
1611	**0.649**	0.000	**0.265**	0.106	**0.600**	0.019	**0.029**	0.013	9.307	0.409	0.413	0.136
1612	**0.599**	0.000	**0.342**	0.065	**0.982**	0.010	**0.063**	0.082	9.843	0.363	0.397	0.314
1621	**0.697**	0.000	**0.202**	0.139	**0.553**	0.025	**0.030**	0.011	9.382	0.403	0.410	0.054
1622	**0.682**	0.000	**0.233**	0.129	**0.852**	0.016	**0.053**	0.127	9.713	0.374	0.384	0.116
1631	**0.207**	0.116	**0.735**	0.000	**0.301**	0.130	**0.038**	0.000	9.515	0.391	0.616	0.168
1632	–0.064	0.663	**0.991**	0.000	**0.958**	0.000	**0.103**	0.001	10.127	0.340	0.622	0.957
1641	**0.588**	0.000	**0.327**	0.036	**0.541**	0.014	**0.030**	0.003	9.463	0.396	0.462	0.092
1642	**0.565**	0.000	**0.352**	0.054	**0.890**	0.007	**0.062**	0.048	9.894	0.359	0.444	0.142
1651	**0.274**	0.087	**0.389**	0.000	**0.260**	0.217	**0.027**	0.006	9.618	0.382	0.536	0.000
1652	–0.013	0.941	**0.577**	0.000	**0.697**	0.004	**0.102**	0.001	9.879	0.360	0.564	0.000
2111	**0.641**	0.000	**0.191**	0.014	**0.203**	0.027	**0.025**	0.000	6.925	0.645	0.414	0.000
2112	**0.420**	0.000	**0.340**	0.000	**0.432**	0.001	**0.078**	0.003	6.203	0.719	0.492	0.000
2121	**0.677**	0.000	**0.167**	0.009	**0.198**	0.033	**0.026**	0.001	7.020	0.635	0.399	0.000
2122	**0.530**	0.000	**0.260**	0.000	**0.387**	0.002	**0.070**	0.005	6.953	0.642	0.474	0.000

2131	**0.562**	0.000	**0.256**	0.002	**0.068**	0.393	**0.031**	0.000	6.066	0.733	0.456	0.000
2132	**0.395**	0.000	**0.321**	0.000	**0.285**	0.032	**0.066**	0.020	9.072	0.431	0.578	0.000
2141	**0.630**	0.000	**0.199**	0.004	**0.153**	0.063	**0.027**	0.000	6.915	0.646	0.438	0.000
2142	**0.481**	0.000	**0.290**	0.000	**0.325**	0.004	**0.068**	0.004	6.860	0.652	0.524	0.000
2151	**0.357**	0.049	**0.233**	0.002	**0.090**	0.186	**0.027**	0.000	5.793	0.760	0.555	0.000
2152	**0.017**	0.900	**0.359**	0.000	**0.213**	0.050	**0.039**	0.025	5.939	0.746	0.641	0.000
2211	**0.609**	0.000	**0.210**	0.004	**0.162**	0.005	**0.024**	0.000	7.829	0.551	0.452	0.000
2212	**0.416**	0.000	**0.302**	0.000	**0.440**	0.000	**0.123**	0.002	7.658	0.569	0.480	0.000
2221	**0.651**	0.000	**0.179**	0.004	**0.155**	0.007	**0.025**	0.000	8.118	0.522	0.433	0.000
2222	**0.523**	0.000	**0.225**	0.001	**0.383**	0.000	**0.107**	0.003	7.805	0.554	0.477	0.000
2231	**0.465**	0.000	**0.313**	0.001	**0.083**	0.131	**0.035**	0.000	5.896	0.750	0.478	0.000
2232	**0.257**	0.026	**0.367**	0.000	**0.535**	0.000	**0.187**	0.000	7.722	0.562	0.249	0.000
2241	**0.594**	0.000	**0.222**	0.001	**0.123**	0.019	**0.026**	0.000	7.799	0.555	0.469	0.000
2242	**0.439**	0.000	**0.283**	0.001	**0.385**	0.000	**0.123**	0.002	7.835	0.551	0.481	0.000
2251	**0.304**	0.055	**0.254**	0.000	**0.069**	0.174	**0.027**	0.000	6.402	0.699	0.566	0.000
2252	–0.032	0.843	**0.368**	0.000	**0.166**	0.048	**0.047**	0.021	6.002	0.740	0.638	0.000
2311	**0.643**	0.000	**0.204**	0.037	**0.270**	0.021	**0.035**	0.001	6.086	0.731	0.326	0.004
2312	**0.490**	0.000	**0.283**	0.002	**0.345**	0.007	**0.052**	0.039	7.815	0.553	0.404	0.001
2321	**0.693**	0.000	**0.165**	0.054	**0.249**	0.022	**0.035**	0.001	5.989	0.741	0.298	0.005
2322	**0.568**	0.000	**0.224**	0.008	**0.292**	0.016	**0.047**	0.046	8.460	0.489	0.392	0.003
2331	**0.544**	0.001	**0.273**	0.009	**0.097**	0.215	**0.032**	0.000	6.499	0.689	0.449	0.003
2332	**0.379**	0.004	**0.369**	0.000	**0.132**	0.178	**0.046**	0.032	6.899	0.648	0.519	0.000
2341	**0.649**	0.000	**0.197**	0.026	**0.212**	0.030	**0.036**	0.000	5.817	0.758	0.340	0.003

Table 3 (cont.)

2342	**0.476**	0.001	**0.287**	0.001	**0.267**	0.013	**0.053**	0.025	7.695	0.565	0.451	0.001
2351	**0.449**	0.033	**0.202**	0.019	**0.175**	0.041	**0.034**	0.000	6.073	0.733	0.448	0.007
2352	**0.071**	0.639	**0.336**	0.000	**0.183**	0.034	**0.025**	0.050	7.428	0.593	0.603	0.000
2411	**0.604**	0.000	**0.217**	0.027	**0.204**	0.057	**0.030**	0.000	6.835	0.654	0.383	0.000
2412	**0.475**	0.000	**0.279**	0.002	**0.283**	0.011	**0.046**	0.050	7.685	0.566	0.420	0.000
2421	**0.658**	0.000	**0.177**	0.034	**0.181**	0.068	**0.031**	0.000	6.825	0.655	0.355	0.000
2422	**0.555**	0.000	**0.224**	0.007	**0.239**	0.024	**0.041**	0.064	8.356	0.499	0.407	0.001
2431	**0.496**	0.003	**0.300**	0.008	**0.064**	0.454	**0.027**	0.000	7.284	0.608	0.507	0.002
2432	**0.395**	0.001	**0.360**	0.000	**0.099**	0.336	**0.038**	0.072	6.885	0.649	0.529	0.000
2441	**0.608**	0.000	**0.213**	0.016	**0.154**	0.083	**0.031**	0.000	6.586	0.680	0.403	0.000
2442	**0.468**	0.001	**0.284**	0.001	**0.216**	0.024	**0.046**	0.034	7.630	0.572	0.466	0.000
2451	**0.377**	0.081	**0.225**	0.011	**0.110**	0.197	**0.028**	0.000	6.607	0.678	0.525	0.003
2452	**0.054**	0.691	**0.346**	0.000	**0.136**	0.044	**0.041**	0.081	6.678	0.671	0.610	0.000
2511	**0.867**	0.000	**0.054**	0.413	**0.715**	0.003	**0.033**	0.002	3.480	0.942	0.293	0.054
2512	**0.755**	0.000	**0.134**	0.045	**0.561**	0.012	**0.008**	0.623	6.324	0.707	0.392	0.058
2521	**0.875**	0.000	**0.046**	0.443	**0.708**	0.004	**0.034**	0.002	3.410	0.946	0.282	0.056
2522	**0.794**	0.000	**0.110**	0.086	**0.573**	0.016	–0.007	0.613	6.542	0.685	0.355	0.091
2531	**0.838**	0.000	**0.069**	0.611	**0.740**	0.000	**0.032**	0.001	4.550	0.872	0.328	0.145
2532	**0.635**	0.000	**0.205**	0.052	**0.586**	0.013	–0.004	0.772	6.229	0.717	0.436	0.009
2541	**0.849**	0.000	**0.066**	0.376	**0.689**	0.005	**0.033**	0.002	3.476	0.942	0.310	0.050
2542	**0.721**	0.000	**0.155**	0.053	**0.530**	0.025	–0.004	0.799	6.151	0.725	0.402	0.045
2551	**0.719**	0.007	**0.086**	0.416	**0.645**	0.005	**0.031**	0.000	5.110	0.825	0.401	0.198
2552	**0.208**	0.296	**0.287**	0.001	**0.378**	0.095	**0.005**	0.726	5.800	0.760	0.584	0.000

2611	**0.469**	0.007	**0.306**	0.022	**0.350**	0.126	**0.019**	0.002	9.060	0.432	0.422	0.000
2612	**0.247**	0.055	**0.440**	0.000	**0.811**	0.001	**0.042**	0.009	9.501	0.392	0.379	0.000
2621	**0.573**	0.000	**0.225**	0.035	**0.237**	0.241	**0.020**	0.000	8.972	0.440	0.399	0.000
2622	**0.392**	0.002	**0.331**	0.002	**0.640**	0.005	**0.031**	0.042	9.699	0.375	0.376	0.000
2631	**0.216**	0.100	**0.478**	0.000	**0.409**	0.032	–0.019	0.181	6.356	0.704	0.373	0.000
2632	**0.193**	0.043	**0.469**	0.000	**0.423**	0.017	**0.046**	0.099	8.579	0.477	0.560	0.000
2641	**0.500**	0.001	**0.280**	0.009	**0.197**	0.245	**0.023**	0.000	8.608	0.474	0.471	0.000
2642	**0.307**	0.013	**0.388**	0.000	**0.587**	0.002	**0.033**	0.030	9.168	0.422	0.478	0.000
2651	–0.127	0.534	**0.424**	0.000	**0.420**	0.051	–0.028	0.097	8.054	0.529	0.362	0.000
2652	–0.169	0.219	**0.423**	0.000	**0.307**	0.014	**0.035**	0.006	8.461	0.488	0.596	0.000

Notes: Table presents GMM estimates of the HNKPC models. The sample period is 2003Q1–2015Q3. The set of instruments contains pre--determined variables, i.e. three lags of the measures of inflation, economic slack and imported inflation used in each of the specifications.

Source: own calculations.

Table 4. Estimation results of the HNKPC, 2003–2012

Model *i_k_m_h*	c_1	c_1-prob	c_2	c_2-prob	c_3	c_3-prob	c_4	c_4-prob	J-stat	J-prob	R^2adj	Dyn. hom. F-prob.
1111	**0.346**	0.000	**0.803**	0.000	**0.646**	0.000	**0.035**	0.000	6.536	0.685	0.433	0.037
1112	**0.012**	0.911	1.216	0.000	**1.230**	0.000	**0.133**	0.001	7.384	0.597	0.516	0.131
1121	**0.414**	0.000	**0.678**	0.000	**0.564**	0.000	**0.035**	0.000	6.530	0.686	0.397	0.021
1122	**0.226**	0.055	**0.876**	0.000	**0.963**	0.000	**0.096**	0.014	7.165	0.620	0.436	0.338
1131	**0.271**	0.012	**0.754**	0.000	**0.369**	0.005	**0.043**	0.002	7.289	0.607	0.531	0.584
1132	–0.001	0.992	**0.995**	0.000	**0.748**	0.000	**0.125**	0.000	7.744	0.560	0.599	0.962
1141	**0.306**	0.001	**0.778**	0.000	**0.404**	0.001	**0.037**	0.000	7.178	0.619	0.458	0.025
1142	**0.247**	0.007	**0.838**	0.000	**0.792**	0.000	**0.149**	0.003	7.201	0.616	0.447	0.190
1151	**0.114**	0.347	**0.562**	0.000	**0.349**	0.007	**0.035**	0.001	7.096	0.627	0.467	0.000
1152	–0.057	0.665	**0.647**	0.000	**0.805**	0.000	**0.202**	0.000	6.459	0.693	0.389	0.001
1211	**0.372**	0.000	**0.719**	0.000	**0.402**	0.000	**0.025**	0.001	6.705	0.668	0.422	0.102
1212	**0.223**	0.001	**0.865**	0.000	**0.730**	0.000	**0.139**	0.001	6.769	0.661	0.500	0.124
1221	**0.411**	0.000	**0.634**	0.000	**0.366**	0.000	**0.024**	0.005	6.651	0.673	0.386	0.294
1222	**0.308**	0.006	**0.712**	0.000	**0.599**	0.000	**0.076**	0.030	6.384	0.701	0.392	0.781
1231	**0.261**	0.013	**0.748**	0.000	**0.216**	0.001	**0.036**	0.000	6.808	0.657	0.549	0.803
1232	**0.007**	0.953	**0.884**	0.000	**0.879**	0.000	**0.265**	0.000	6.111	0.729	0.420	0.452
1241	**0.296**	0.000	**0.757**	0.000	**0.255**	0.003	**0.028**	0.001	7.241	0.612	0.460	0.161
1242	**0.230**	0.087	**0.796**	0.000	**0.461**	0.002	**0.076**	0.023	6.678	0.671	0.456	0.678
1251	**0.091**	0.453	**0.567**	0.000	**0.176**	0.095	**0.021**	0.006	7.430	0.592	0.478	0.000

1252	–0.118	0.407	**0.647**	0.000	**0.604**	0.000	**0.183**	0.000	6.752	0.663	0.474	0.001
1311	**0.300**	0.002	**0.864**	0.000	**0.901**	0.000	**0.042**	0.000	8.305	0.504	0.456	0.286
1312	**0.274**	0.022	**0.908**	0.000	**0.851**	0.000	**0.035**	0.071	7.942	0.540	0.362	0.473
1321	**0.458**	0.000	**0.597**	0.000	**0.798**	0.000	**0.041**	0.000	8.604	0.475	0.389	0.302
1322	**0.440**	0.000	**0.626**	0.000	**0.754**	0.000	**0.063**	0.026	8.287	0.506	0.287	0.342
1331	**0.183**	0.206	**0.851**	0.000	**0.428**	0.035	**0.041**	0.000	7.988	0.535	0.535	0.489
1332	**0.078**	0.558	**0.954**	0.000	**0.506**	0.001	**0.102**	0.003	7.350	0.601	0.429	0.777
1341	**0.322**	0.002	**0.743**	0.000	**0.643**	0.000	**0.042**	0.000	8.346	0.500	0.454	0.134
1342	**0.256**	0.077	**0.822**	0.000	**0.570**	0.003	**0.036**	0.084	7.705	0.564	0.372	0.207
1351	–0.090	0.679	**0.692**	0.000	**0.702**	0.002	**0.047**	0.000	6.379	0.702	0.449	0.033
1352	–0.190	0.249	**0.768**	0.000	**0.352**	0.081	**0.118**	0.000	7.297	0.606	0.320	0.047
1411	**0.233**	0.021	**0.884**	0.000	**0.854**	0.000	**0.039**	0.000	7.742	0.560	0.452	0.357
1412	**0.169**	0.119	**0.983**	0.000	**0.843**	0.000	**0.039**	0.098	8.066	0.528	0.369	0.894
1421	**0.395**	0.000	**0.621**	0.000	**0.778**	0.000	**0.040**	0.000	8.230	0.511	0.392	0.781
1422	**0.367**	0.000	**0.664**	0.000	**0.751**	0.000	**0.068**	0.050	8.384	0.496	0.290	0.641
1431	**0.102**	0.512	**0.947**	0.000	**0.255**	0.086	**0.038**	0.000	7.267	0.609	0.522	0.764
1432	**0.015**	0.912	**0.984**	0.000	**0.471**	0.002	**0.069**	0.010	7.828	0.552	0.442	0.983
1441	**0.275**	0.009	**0.757**	0.000	**0.631**	0.000	**0.041**	0.000	7.918	0.542	0.454	0.484
1442	**0.203**	0.077	**0.840**	0.000	**0.631**	0.000	**0.077**	0.015	8.191	0.515	0.369	0.432
1451	–0.020	0.920	**0.628**	0.000	**0.567**	0.001	**0.042**	0.000	6.675	0.671	0.475	0.006
1452	–0.194	0.241	**0.764**	0.000	**0.298**	0.124	**0.115**	0.000	7.337	0.602	0.319	0.039
1511	**0.552**	0.000	**0.483**	0.000	**0.868**	0.001	**0.032**	0.014	8.014	0.533	0.284	0.466
1512	**0.547**	0.000	**0.537**	0.001	**0.820**	0.034	**0.007**	0.796	6.759	0.662	0.130	0.310

Table 4 (cont.)

1521	**0.603**	0.000	**0.396**	0.000	**0.768**	0.007	**0.033**	0.016	8.174	0.517	0.249	0.977
1522	**0.592**	0.000	**0.445**	0.004	**0.693**	0.103	**0.003**	0.894	6.744	0.664	0.095	0.618
1531	**0.376**	0.000	**0.617**	0.000	**0.717**	0.001	**0.040**	0.000	7.764	0.558	0.473	0.853
1532	**0.170**	0.107	**0.789**	0.000	**1.212**	0.001	**0.105**	0.020	5.961	0.744	0.452	0.446
1541	**0.444**	0.000	**0.582**	0.000	**0.638**	0.015	**0.036**	0.001	7.738	0.561	0.362	0.541
1542	**0.315**	0.002	**0.707**	0.000	**0.910**	0.012	**0.060**	0.153	7.031	0.634	0.353	0.713
1551	**0.232**	0.058	**0.466**	0.000	**0.884**	0.000	**0.037**	0.001	7.972	0.537	0.445	0.000
1552	–0.090	0.530	**0.697**	0.000	**0.627**	0.022	**0.066**	0.002	7.171	0.619	0.483	0.010
1611	**0.097**	0.348	1.099	0.000	**1.069**	0.001	**0.014**	0.131	8.080	0.526	0.276	0.578
1612	**0.071**	0.626	1.142	0.000	**1.250**	0.001	**0.050**	0.141	8.318	0.502	0.257	0.438
1621	–0.070	0.589	1.139	0.000	**1.271**	0.002	**0.028**	0.000	6.687	0.670	0.063	0.501
1622	–0.092	0.579	1.212	0.000	**1.951**	0.000	**0.121**	0.001	7.305	0.605	0.144	0.327
1631	–0.186	0.109	1.134	0.000	**0.857**	0.002	**0.034**	0.000	6.708	0.667	0.443	0.406
1632	–0.157	0.262	1.187	0.000	**0.740**	0.001	**0.086**	0.036	7.465	0.589	0.413	0.578
1641	**0.059**	0.571	1.020	0.000	**0.719**	0.018	**0.016**	0.157	7.997	0.534	0.356	0.889
1642	–0.176	0.248	1.280	0.000	**1.235**	0.000	**0.099**	0.000	7.532	0.582	0.347	0.101
1651	–0.128	0.408	**0.721**	0.000	**0.035**	0.898	**0.017**	0.065	8.314	0.503	0.427	0.024
1652	–0.458	0.000	**0.913**	0.000	**0.385**	0.139	**0.114**	0.000	7.488	0.586	0.421	0.252
2111	**0.709**	0.000	**0.216**	0.001	**0.238**	0.001	**0.025**	0.002	7.858	0.549	0.390	0.054
2112	**0.511**	0.001	**0.357**	0.000	**0.452**	0.007	**0.043**	0.070	7.891	0.545	0.461	0.074
2121	**0.736**	0.000	**0.185**	0.001	**0.236**	0.002	**0.024**	0.002	7.890	0.545	0.369	0.038
2122	**0.679**	0.000	**0.199**	0.009	**0.539**	0.000	**0.108**	0.001	7.530	0.582	0.310	0.008
2131	**0.668**	0.000	**0.202**	0.001	**0.149**	0.021	**0.028**	0.001	7.152	0.621	0.431	0.000

2132	**0.588**	0.000	**0.226**	0.003	**0.484**	0.000	**0.113**	0.001	8.179	0.516	0.399	0.000
2141	**0.688**	0.000	**0.214**	0.000	**0.179**	0.011	**0.025**	0.001	7.934	0.541	0.408	0.004
2142	**0.644**	0.000	**0.216**	0.006	**0.483**	0.001	**0.107**	0.001	7.499	0.585	0.343	0.003
2151	**0.522**	0.000	**0.187**	0.001	**0.132**	0.053	**0.023**	0.001	7.873	0.547	0.510	0.000
2152	**0.266**	0.036	**0.273**	0.000	**0.534**	0.000	**0.137**	0.001	6.391	0.700	0.391	0.000
2211	**0.681**	0.000	**0.228**	0.004	**0.131**	0.010	**0.016**	0.000	8.252	0.509	0.433	0.029
2212	**0.501**	0.000	**0.294**	0.001	**0.422**	0.000	**0.109**	0.000	7.211	0.615	0.454	0.000
2221	**0.598**	0.000	**0.272**	0.000	**0.174**	0.000	**0.014**	0.000	8.094	0.525	0.437	0.000
2222	**0.581**	0.000	**0.224**	0.002	**0.385**	0.000	**0.099**	0.001	7.256	0.610	0.424	0.000
2231	**0.625**	0.000	**0.225**	0.001	**0.082**	0.094	**0.022**	0.000	7.557	0.579	0.494	0.000
2232	**0.444**	0.000	**0.269**	0.000	**0.429**	0.000	**0.132**	0.000	7.718	0.563	0.454	0.000
2241	**0.649**	0.000	**0.238**	0.001	**0.089**	0.067	**0.017**	0.000	8.194	0.515	0.451	0.002
2242	**0.531**	0.000	**0.253**	0.002	**0.362**	0.000	**0.106**	0.001	7.162	0.620	0.437	0.000
2251	**0.366**	0.003	**0.247**	0.000	**0.072**	0.152	**0.014**	0.000	7.792	0.555	0.585	0.000
2252	–0.003	0.982	**0.348**	0.000	**0.339**	0.000	**0.112**	0.000	5.044	0.830	0.573	0.000
2311	**0.729**	0.000	**0.205**	0.014	**0.348**	0.000	**0.026**	0.000	7.159	0.621	0.388	0.109
2312	**0.712**	0.000	**0.208**	0.006	**0.374**	0.003	**0.040**	0.043	7.698	0.565	0.343	0.220
2321	**0.772**	0.000	**0.158**	0.035	**0.336**	0.000	**0.025**	0.000	7.883	0.546	0.358	0.095
2322	**0.763**	0.000	**0.160**	0.020	**0.350**	0.005	**0.037**	0.060	8.152	0.519	0.310	0.234
2331	**0.704**	0.000	**0.188**	0.012	**0.223**	0.004	**0.025**	0.000	7.009	0.636	0.432	0.035
2332	**0.659**	0.000	**0.204**	0.002	**0.249**	0.026	**0.042**	0.027	7.647	0.570	0.403	0.041
2341	**0.728**	0.000	**0.185**	0.009	**0.296**	0.000	**0.026**	0.000	7.477	0.588	0.391	0.028
2342	**0.706**	0.000	**0.195**	0.005	**0.313**	0.007	**0.040**	0.036	7.822	0.552	0.354	0.136

Table 4 (cont.)

2351	**0.542**	0.001	**0.180**	0.004	**0.250**	0.001	**0.025**	0.000	6.871	0.651	0.502	0.005
2352	**0.294**	0.032	**0.271**	0.000	**0.229**	0.029	**0.055**	0.038	7.397	0.596	0.543	0.000
2411	**0.659**	0.000	**0.238**	0.005	**0.330**	0.000	**0.023**	0.000	6.819	0.656	0.434	0.032
2412	**0.648**	0.000	**0.231**	0.004	**0.340**	0.002	**0.037**	0.029	7.322	0.604	0.374	0.067
2421	**0.697**	0.000	**0.195**	0.012	**0.321**	0.000	**0.022**	0.000	7.464	0.589	0.405	0.026
2422	**0.704**	0.000	**0.179**	0.016	**0.324**	0.002	**0.034**	0.037	7.740	0.561	0.339	0.074
2431	**0.626**	0.000	**0.227**	0.002	**0.202**	0.005	**0.022**	0.000	6.845	0.653	0.487	0.014
2432	**0.586**	0.000	**0.235**	0.001	**0.231**	0.010	**0.041**	0.012	7.019	0.635	0.436	0.009
2441	**0.668**	0.000	**0.210**	0.002	**0.275**	0.000	**0.023**	0.000	7.124	0.624	0.431	0.008
2442	**0.650**	0.000	**0.212**	0.004	**0.287**	0.003	**0.037**	0.019	7.502	0.585	0.381	0.043
2451	**0.499**	0.001	**0.185**	0.001	**0.239**	0.001	**0.022**	0.000	6.633	0.675	0.532	0.001
2452	**0.304**	0.029	**0.263**	0.000	**0.228**	0.007	**0.023**	0.048	7.274	0.609	0.567	0.000
2511	**0.826**	0.000	**0.094**	0.352	**0.561**	0.011	**0.018**	0.009	7.545	0.581	0.346	0.065
2512	**0.644**	0.000	**0.263**	0.011	**0.473**	0.050	**0.036**	0.091	6.894	0.648	0.332	0.112
2521	**0.693**	0.000	**0.217**	0.005	**0.313**	0.014	**0.016**	0.005	7.961	0.538	0.353	0.058
2522	**0.686**	0.000	**0.215**	0.017	**0.462**	0.070	**0.032**	0.163	7.161	0.620	0.296	0.101
2531	**0.599**	0.000	**0.245**	0.001	**0.185**	0.115	**0.017**	0.003	7.143	0.622	0.480	0.004
2532	**0.610**	0.000	**0.220**	0.010	**0.396**	0.136	**0.040**	0.074	7.041	0.633	0.411	0.006
2541	**0.626**	0.000	**0.260**	0.002	**0.189**	0.153	**0.016**	0.005	7.837	0.551	0.421	0.011
2542	**0.642**	0.000	**0.237**	0.007	**0.375**	0.136	**0.035**	0.094	6.957	0.642	0.357	0.046
2551	**0.525**	0.001	**0.179**	0.009	**0.400**	0.026	**0.016**	0.001	7.248	0.611	0.528	0.001
2552	**0.177**	0.297	**0.337**	0.000	**0.024**	0.877	**0.018**	0.065	6.585	0.680	0.581	0.000
2611	**0.310**	0.034	**0.507**	0.000	**0.619**	0.010	**0.012**	0.061	7.525	0.583	0.464	0.001

2612	**0.047**	0.646	**0.711**	0.000	**0.854**	0.000	**0.024**	0.058	7.768	0.558	0.384	0.001
2621	**0.397**	0.010	**0.411**	0.001	**0.580**	0.013	**0.011**	0.114	7.443	0.591	0.396	0.003
2622	**0.232**	0.025	**0.505**	0.000	**0.915**	0.000	**0.059**	0.065	7.096	0.627	0.289	0.000
2631	**0.296**	0.015	**0.411**	0.000	**0.283**	0.027	**0.021**	0.000	7.189	0.617	0.571	0.000
2632	**0.202**	0.041	**0.460**	0.000	**0.728**	0.000	**0.046**	0.001	7.409	0.595	0.567	0.000
2641	**0.392**	0.006	**0.399**	0.000	**0.418**	0.025	**0.014**	0.006	7.603	0.575	0.488	0.000
2642	**0.227**	0.014	**0.477**	0.000	**0.897**	0.000	**0.044**	0.003	7.581	0.577	0.459	0.000
2651	**0.068**	0.534	**0.362**	0.000	**0.394**	0.020	–0.010	0.347	7.368	0.599	0.529	0.000
2652	–0.165	0.262	**0.424**	0.000	**0.482**	0.001	**0.064**	0.027	6.398	0.699	0.525	0.000

Notes: Table presents GMM estimates of the HNKPC models. The sample period is 2003Q1–2015Q3. The set of instruments contains pre--determined variables, i.e. three lags of the measures of inflation, economic slack and imported inflation used in each of the specifications.

Source: own calculations.

UŻYTECZNOŚĆ KRZYWEJ PHILLIPSA W INTERPRETACJI OKRESU NISKIEJ INFLACJI W POLSCE

STRESZCZENIE

Deflacja w Polsce, podobnie jak niska inflacja w gospodarkach rozwiniętych, zwłaszcza w strefie euro, wydaje się zaskakująco długotrwała. W niniejszym artykule podjęto próbę sprawdzenia, na ile wersje tradycyjna i hybrydowa nowokeynesistowskiej krzywej Phillipsa (NKPC, HNKPC) są użyteczne w analizie przebiegu procesów inflacyjnych w Polsce, zwłaszcza w ostatnim okresie. W celu uodpornienia wniosków z przeprowadzanego badania, estymując nowokeynesistowską krzywą Phillipsa, wzięto pod uwagę różne zmienne reprezentujące: inflację, oczekiwania inflacyjne, presję popytową oraz inflację importowaną.

Z wyników analizy wynika, że ostatnia dezinflacja w Polsce, rozpoczęta w 2012 r. i skutkująca przedłużającym się okresem deflacji, była spowodowana nie tylko spadkiem cen surowców, ale również czynnikami popytowymi i obniżonymi oczekiwaniami inflacyjnymi. Pokazano, że w celu dobrego wyjaśnienia okresu dezinflacji z wykorzystaniem HNKPC w estymacji tej zależności należy wykorzystać specyficzny zestaw zmiennych objaśniających. Powinien on zawierać ankietowe miary oczekiwań inflacyjnych podmiotów gospodarczych (przede wszystkim przedsiębiorstw), przekształconą miarę luki popytowej uwzględniającą jej silniejszy wpływ na inflację w okresach dobrej koniunktury lub odchylenie tempa wzrostu realnego PKB od swej średniej, jak również lukę realnego efektywnego kursu walutowego.

Analizując stabilność krzywej Phillipsa estymowanej w kategoriach inflacji bazowej, dostrzegamy przesłanki świadczące o jej spłaszczeniu w ostatnich latach. Jednocześnie modele, w których zmienną objaśnianą jest inflacja CPI, pokazują raczej wypiętrzenie krzywej Phillipsa. Obie grupy modeli wskazują jednak zgodnie, że w ostatnich latach wpływ oczekiwań inflacyjnych na inflację uległ osłabieniu.

Słowa kluczowe: inflacja, deflacja, hybrydowa nowokeynesistowska krzywa Phillipsa, Polska.
JEL Classification: E31, E37